



**Joint Institute for Nuclear
Research**

SCIENCE BRINGING NATIONS TOGETHER

**COMPARITAVE ANALYSIS OF WORKING
ORGANIZATION IN ACCELERATOR COMPLEX
FACILITIES: THE LARGE HADRON COLLIDE (LHC)
AND NUCLOTRON-BASED ION COLLIDER FACILITY
(NICA)**

Supervisor:

Eng. Nikita Baldin

Prepared by:

Nour Ahmed Wahban

Alexandria university

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Abstract

The analysis of work organization term at the JINR nuclotron-based ion collider facility (NICA) and the CERN large hadron collider (LHC) is covered in this report. This work was done as part of the INTEREST wave 9 program, where we covered a variety of organizational structure parameters, such as the number of personnel, the number of shifts, and the composition of the shifts. work operations, including shifters' responsibilities and roles. technological services, such as planning systems and service platforms. System of training and development with feedback and assessment. system for reporting with tools for tracking and documentation. This report aims to provide a valuable comparison table between LHC and NICA in terms of working organization.

Introduction

During the program we performed a variety of tasks to cover the work organization parameters in both facilities. We tried to break the term into set of parameters where we relied on global standards associated with the establishment of control rooms and organizational structures in the field of operating technological facilities. Additionally, we identified the quantitative and qualitative characteristics that can be used for comparison. For example, the services, shifts, operators and preparatory courses.

In summary, this comparative analysis will assist us in comprehending how the work arrangements in the LHC and NICA complexes facilitate studies, encourage teamwork, guarantee safety and security, distribute resources effectively, and produce outstanding research products. To achieve scientific and technological developments, we can push for more effective and efficient work structures by understanding the pros and cons of these organizations.

NICA complex description

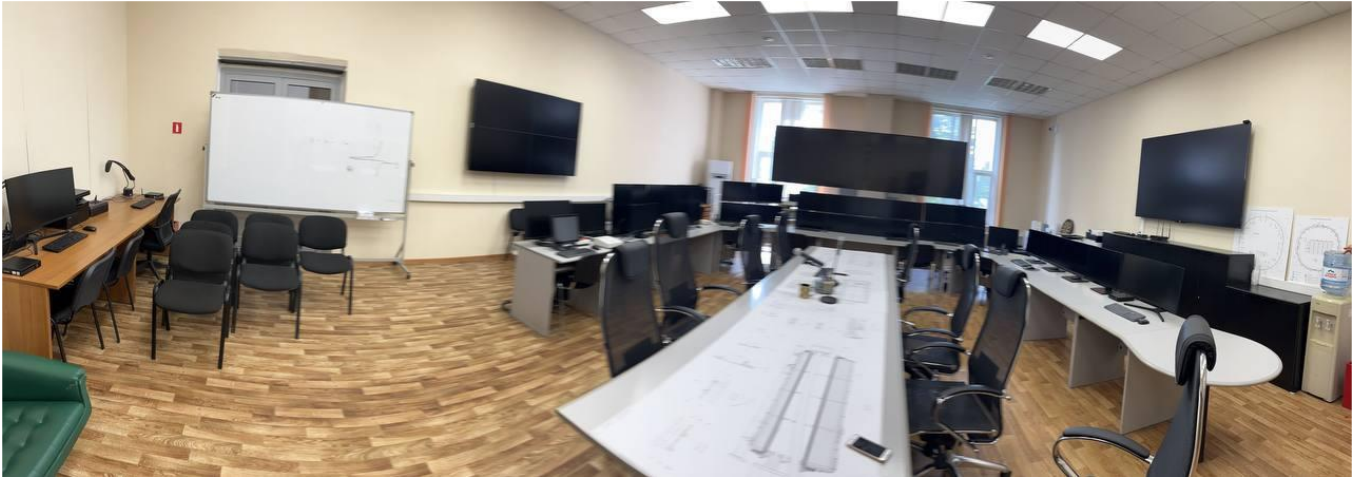


Figure 1: NICA central control room

The organizational structure of the work inside NICA facility reflects the diverse nature and the essential roles played by each component. In NICA they have one main control room, one control suit and 6 other control rooms. To guarantee the effective operation and maintenance of the complex, shifters including shift leader, operator and dispatcher must be distributed among several control rooms and an On-Call team must be present. In NICA they have 2 shifts of 12 hours each.

NICA's training protocols ensure safety and work capability. Operators undergo a comprehensive educational journey, combining technical and academic instruction to understand complex management processes. They learn about JINR organization regulations and manage various systems and subsystems. Exams are used to ensure understanding of roles. Junior operators are introduced through supervised shifts and limited direct control, with task management autonomy granted after proving their ability and completing work without mistakes.

The training process at NICA involves:

- 1) Lectures
- 2) Manuals
- 3) Annual examinations.

LHC complex description



Figure 2: LHC control center

The work organization in CERN control center (CCC) is designed to perform certain tasks efficiently and well organized. Tasks are distributed among skilled operators and eligible expertise. The accelerator operators oversee managing, upkeep, and smooth operation of these facilities and accelerators to support a variety of scientific research projects and investigations. In terms of operations, there are 7 operators per shift. They are as follows: One operator for the Large Hadron Collider (LHC), two operators for the Proton Synchrotron Booster (PSB), one operator for the Proton Synchrotrons (PS), two operators for the Super Proton Synchrotron (SPS), one operator for the LHC, and one Engineer in Charge (LHC EIC), who works cooperatively with the LHC Operator during LHC operations. In LHC they have 3 shifts (8 hours each)

Operator training at the CERN Control Centre (CCC) is a vital component in enabling the safe and efficient running of the Large Hadron Collider (LHC), a premier example of one of the most complex scientific projects in history. This training program includes a wide range of critical components that are carefully crafted to provide operators with the necessary skills and knowledge for the tasks they are entrusted with.

The training protocol at LHC involves:

- 1) Lectures,
- 2) Simulation,
- 3) Manuals,
- 4) Test (Exam).

Comparison table

Organizational structure

	NICA	LHC
Type of personnel	Shift leader, operators, dispatcher, tech-operator, on call experts	Shift leader, Junior operator, senior operator, on call experts
Number of shifts	2 shifts (morning- Night)- 12 hour each	3 shifts (Morning- Afternoon- Night)- 8 hours each
Number of operators per shift	12 operator	7 up to 13 operator
Shift composition	<ul style="list-style-type: none"> • 2 operators in central control room • 6 operators in linear accelerator • 2 operators in water source control room • 2 operators in Main Power Supplies Control Room • 2 operators in RF system control room • 7 operators in cryogenics 	<ul style="list-style-type: none"> • 1 operator in LHC island • 2 operators in PSB island • 1 operator in PS island • 2 operators for SPS island • 1 operator for LHC EIC

Work process and operations

Shift Leader	Supervision and Coordination, Decision-making and Problem Solving, Communication and Collaboration, Documentation and Reporting.
operator	Monitoring and Data Analysis, Control and Configuration, Troubleshooting and Response, Documentation and Reporting.
On call	Remote Support, Decision-making and Escalation, Availability and Responsiveness, Documentation and Reporting.

Training and development system

Training system	<ul style="list-style-type: none"> • Lectures • Manuals • Annual examinations. 	<ul style="list-style-type: none"> • Lectures • Simulation • Manuals • Test (Exam).
Number of training courses	15	14
Evaluation and Feedback	Training Evaluations Performance Assessments Feedback Sessions	

Technological services

Services platform	Open edu at JINR (for courses)	OP web tools
Planning and scheduling		Planning application, excel sheets, Planning dashboard
Types of services		Illustrated in figure 3

Documentation and Reporting

Reporting and tracking	E-logbooks White board Personal notebook Paper logbooks Microsoft notebook
Documentation tools	CERN Document Server (CDS)

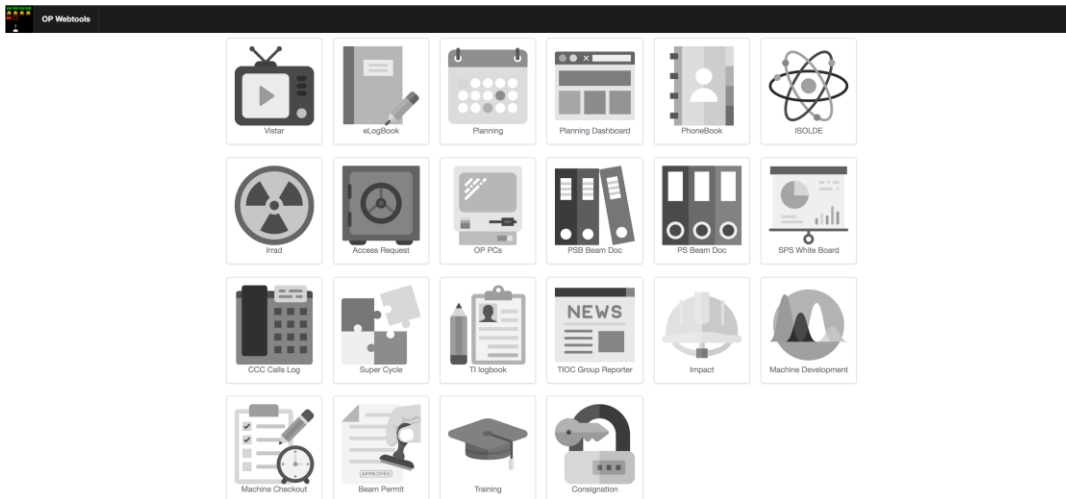


Figure 3: OP web tools

Conclusion

In conclusion, this report examines the differences and similarities between the Nuclotron-based Ion Collider Facility (NICA) and the Large Hadron Collider (LHC). The Large Hadron Collider (LHC) and the Nuclotron-based Ion Collider Facility (NICA) are two distinct yet complementary facilities in particle physics research. The LHC, located at CERN, exemplifies international collaboration and fosters a diverse community of scientists and engineers working across borders. Its operational model emphasizes coordination among experiments and research initiatives, contributing to a vibrant scientific atmosphere. On the other hand, the NICA facility, based at the Joint Institute for Nuclear Research (JINR), focuses on localized approaches, leveraging the expertise and resources within a specific institution. It emphasizes training and controlled access for junior operators, demonstrating the importance of in-house expertise and structured training. Both facilities contribute uniquely to our understanding of the universe.

Reference

- 1) Joint Institute for Nuclear Research (JINR) Official Website: <http://www.jinr.ru/>.
- 2) The European Organization for Nuclear Research (CERN) <https://home.cern/>.